The Use of a Trephine Biopsy Needle to Obtain Autogenous Corticocancellous Bone from the Iliac Crest: Technical Note

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In the absence of adequate bone height, augmentation of the maxillary antrum prior to placement of endosseous implants is a well-established procedure. Although there is a debate among clinicians as to which grafting materials are the most advantageous, autogenous bone is still considered by many to be the gold standard. Often patients require more graft material than is generally available from intraoral sites. This has led clinicians to utilize allografts, xenografts, or a combination of autologous and synthetic bone. Extraoral sites can provide a greater volume of autogenous bone than intraoral sites. However, harvesting extraoral donor bone is frequently associated with adverse consequences in excess of the primary objective (ie, the placement of endosseous implants in the posterior maxilla with minimal morbidity). A method for obtaining a significant volume of corticocancellous autogenous bone for augmentation of the maxillary antrum is described. The technique is efficacious and cost effective and results in minimal morbidity. INT J ORAL MAXILLOFAC IMPLANTS 2004;19:438–442

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Augmentation of the floor of the maxillary sinus where there is insufficient bone height in the posterior maxilla to facilitate placement of endosseous implants is a well-established procedure. This procedure, initially introduced by Tatum[1] and subsequently modified by Wood and Moore,[2] has shown predictable, long-term success.[3–9] Although there is debate among clinicians as to what grafting materials are the most advantageous, autogenous bone is still considered by many to be the gold standard.[10–14] The volume of graft material that can be obtained from intraoral sites is insufficient to obturate a large sinus space. This has lead many clinicians to utilize allografts, xenografts, or a combination of autogenous and synthetic bone.

Several studies have included histologic analysis of the use of nonautogenous bone substitutes in sinus augmentation procedures.[15–20] A consistent finding is that the resorption and maturation of bone are delayed when autogenous grafts are combined with allografts or xenografts. Nishibori and colleagues[16] compared demineralized freeze-dried bone (DFDB) and autogenous bone at 8 and 16 months postgrafting. They found that new bone formation of higher quantity and quality occurred with autogenous bone at both 8 and 16 months. Remnants of DFDB were present at 16 months. Haas and coworkers[17] compared sinus augmentation with simultaneous implant placement in sheep using DFDB and autogenous bone histologically and histomorphometrically. A consistent finding was particles of DFDB surrounded by collagenous connective tissue and both mononucleated and multinucleated giant cells. Also, approximately 50% less bone-to-implant contact was found in the DFDB group than in the autogenous group. They

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Fig 1a Palpation of the posterior iliac crest is used to identify the selected extraction site, which is then marked on the skin.

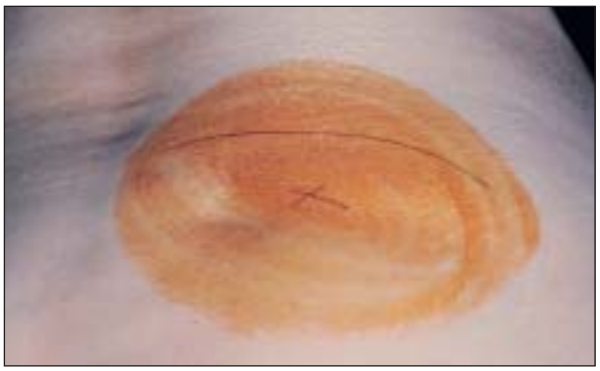

Fig 1b A provodone-iodine solution disinfects the skin surface.

concluded that DFDB homografts and heterografts could not be recommended in place of cancellous autografts from the iliac crest for sinus elevations. Wallace and associates[18] reported on their sequential histologic analysis of healing from 4 to 20 months where a mixture of 80% xenograft and 20% autogenous bone was used. They found that 12 to 20 months were required for complete remodeling of the graft material to vital bone, which was much longer than the healing period required using autogenous bone alone. Other researchers have reported similar results of delayed resorption and maturation with a smaller volume of viable bone.[19–24]

Donor sites for autogenous bone can be either intra- or extraoral. The use of intraoral sites has been associated with less morbidity. Furthermore, general anesthesia or hospitalization is not required to harvest the bone.[25] However, the volume of bone that can be harvested intraorally is limited. Other considerations are the complications and long-term morbidity of some intraoral sites such as the chin. Common complications include significant disturbances of inferior alveolar nerve function and loss of pulpal sensitivity of the teeth near the donor site.[26–30]

Common extraoral sites for augmentation of the maxilla are the anterior and posterior iliac crests.[31,32] The advantages of posterior ilium bone for transplant include increased resistance to infection and excellent osteogenic potential. The posterior iliac crest is also an especially rich donor site for spongy bone; bone harvested from the anterior crest may be less suitable.[33] In a cadaver study, Hall and associates[34] compared the amounts of graft material present in the anterior and posterior ilium. The average volume of surgically available cancellous bone was found to be greater in the posterior ilium.

Use of the ilium as a source for autogenous bone has been extensively described. However, most of the surgical procedures are associated with adverse sequelae. Many authors have reported significant complications with harvesting block grafts from the ilium, the most common being postoperative pain and gait problems.[11,35–38] Other serious sequelae include hematomas, seromas, paresthesias, wound infections, fractures, and abdominal and urologic disturbances.[39–43] The method for obtaining a significant volume of corticocancellous autogenous bone described in this report is efficacious and cost effective and results in minimal morbidity.

MATERIALS AND METHODS

A 4-inch, 8-gauge Jamshidi trephine biopsy needle (Cardinal Health, McGaw Park, IL) is used according to the technique described by Jamshidi and Swaim.[44] Prior to the procedure, the surgeon determines that there are no contraindications to the bone extraction procedure or conscious sedation. The superior edge of the posterior iliac crest is the preferred site for extraction, but the anterior iliac crest also can be used. The patient lies either prone or supine, depending on the site to be used. The site for extraction is selected by palpation, and the skin is marked for reference (Fig 1a). The skin is prepared with a provodone-iodine combination, which is removed with isopropyl alcohol (Fig 1b). Conscious sedation with intravenous midazolam and meperidine or morphine is started at this time.[45]

Using a sterile technique, the previously marked and prepared sites are anesthetized by infiltration with 1% lidocaine using a 2-inch, 21-gauge needle. A 3- to 5-mm incision is made with a no. 15 scalpel blade into the skin over the site. The biopsy needle is inserted into the subcutaneous tissue through the incision with stylet in place. From the posterior iliac spine, at a location 4 to 5 cm from the midline, the biopsy needle is inserted at a 20- to 30-degree angle

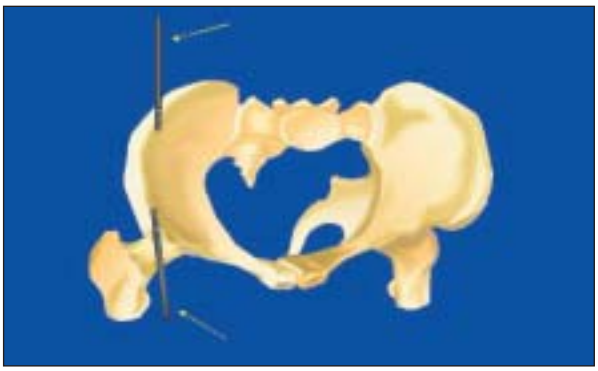

Fig 2 Diagram of the inclination of the biopsy needle for both the posterior and anterior approaches to the iliac crest.

Fig 3 The biopsy needle contacts the cortical bone, the inner stylet is removed, and the needle is advanced into the bone. Multiple bone cores are obtained by inserting the needle into the same skin incision and changing angles toward the new sites.

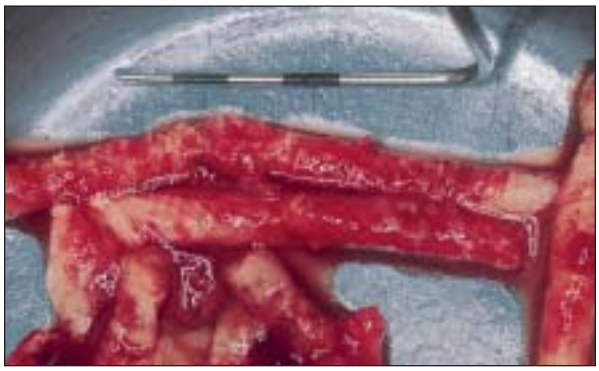

Fig 4 Generally, 6 to 15 cores can be harvested, which provides the surgeon with a significant volume of autogenous bone.

toward the anterior iliac crest. From the anterior iliac approach, the biopsy needle is angled toward the posterior iliac crest (Fig 2). The biopsy needle is pushed down to the bone (Fig 3). After making contact with the cortex of the bone, the inner stylet is removed. The biopsy needle is advanced into the bone by rotating the needle in a clockwise-counterclockwise motion. The needle is advanced as deep as possible, pulled back 0.25 cm, and then pushed down again at a slightly different angle to free the core of bone from the surrounding tissue. The needle is withdrawn using a twisting motion similar to that employed during insertion. The tissue core is removed and placed in a sterile screw-top container containing a saline-saturated gauze pad for storage or transport.

The inner stylet is replaced into the biopsy needle and reinserted through the skin incision into the bone at a different angle. This process typically is repeated 3 to 4 times to obtain tissue cores measuring 1 to 4 cm in length (Fig 4). If needed, the same procedure is used on the opposite iliac crest with a new biopsy needle. Using both iliac crests, a total of 6 to 15 bone cores can be extracted.

If more tissue is required the anterior iliac crests can also be used. The patient, who is sedated, is rolled over from the prone to the supine position to continue bone harvesting from the opposite approach. For obese patients, the anterior iliac crest should be used because there is much less subcutaneous tissue and fat in this region. The Jamshidi biopsy needles are only 4 inches long and cannot penetrate deep enough into the bone through the posterior iliac crest approach in obese patients.

The extraction of bone from both iliac crests takes approximately 1.5 hours to complete in addition to the initial medical interview.

DISCUSSION

Obtaining autogenous bone from the ilium for periodontal and minor medical bone transplantation using a trephine biopsy needle has been described previously.[46–49] This method, commonly used by medical oncologists for evaluation of the medical patient with malignant lymphoma or Hodgkin's disease, retrieves an adequate amount of well-compressed bone with limited surgical exposure while reducing postoperative pain, loss of muscle function, and possible paralytic ileus.[50]

There are several different brands or types of bone marrow biopsy needles available. Whatever needle the participating surgeon prefers should be adequate. However, the volume of tissue is a critical factor. A larger bone needle will require fewer samples to be taken. For example, the Jamshidi needle is available in 3 sizes (13, 11, and 8 gauge). The largest, the 8-gauge needle, is used for the bone extraction process.

The exact sites of the iliac bone used are slightly different for the bone-extraction procedure than those that are generally used for diagnostic biopsies.

For the typical diagnostic biopsy, the flat area of the posterior pelvis may be easier to use. Since the cortex of the bone is thinner in the flat area, the procedure may be easier. However, for bone grafting to enhance a site for the placement of a dental implant, cortical bone can be used. For this reason the lip of the superior edge of the iliac crest, where the cortex is thick, is used, and not the surface of the ilium bone. This results in increased lengths of extracted cortical bone cores.

Conscious sedation is commonly used for brief surgical procedures. One of the authors (MMT) has performed more than 250 diagnostic bone marrow biopsies with almost no complications. A single patient had postbiopsy pain intense enough to require analgesics containing hydrocodone for 2 days. Less than 5% of his patients needed postbiopsy over-the-counter analgesics. Skin irritation occurred in an even smaller number of patients. There were no instances of excessive bleeding, hematomas, infection, long-lasting discomfort or pain, loss of mobility, fractured bone, or broken needles. All of the bone biopsies and extractions have been done as an outpatient treatment; hospitalization is not required.

The harvesting of bone for implantation requires many more entries into the bone than is required for diagnostic evaluation, thus increasing the potential risk for complications. Since the ilium is a relatively large bone, removing multiple cores of tissue does not weaken it. Weight-bearing movement such as walking should not produce a problem. Although there is a risk of infection or bleeding, the risk is very small. If a patient has a bone disease such as osteoporosis, there can be an increased risk of bone fracture, resulting in pain and impaired mobility. Up to 4 biopsy needles have been used during the procedure because the needle gradually becomes dull with repeated entries into the bone, thus compromising the ability to obtain adequate amounts of tissue easily. If one needed a large number of cores, it would require the use of both posterior and anterior iliac crests, and more than 4 needles would probably be needed.

CONCLUSION

The plethora of processed or synthetic bone substitutes is a response to the surgeon's desire to avoid the disadvantages of harvesting autogenous bone (second surgical site, increased mobidity, and increased cost). However, many of these materials have been found to be lacking in osteogenic potential, remain intact for extensive periods of time, and result in decreased bone-to-implant surface contact. A method for obtaining adequate volumes of autogenous bone from the ilium specifically for sinus augmentation procedures in conjunction with placement of endosseous implants in the posterior maxilla has been described. This technique is a modification of the common diagnostic bone biopsy frequently performed by medical oncologists. The advantages include reduced risk and postoperative discomfort, the ability to harvest a significant amount of corticocancellous bone without hospitalization, and reduced cost.

REFERENCES

1. Tatum H. Maxillary and sinus implant reconstruction. Dent Clin North Am 1986;30:207–229.
2. Wood R, Moore D. Grafting of the maxillary sinus with intraorally harvested autogenous bone prior to implant placement. Int J Oral Maxillofac Implants 1988;3:209–214.
3. Small S, Zinner ID, Panno FV, Shapiro HJ, Stein JI. Augmenting the maxillary sinus for implants. Report of 27 patients. Int J Oral Maxillofac Implants 1993;8:523–528.
4. Chanavaz M. Maxillary sinus: Anatomy, physiology, surgery and bone grafting related to implantology. Eleven years of surgical experience (1979–1990). J Oral Implantol 1990; 16:199–209.
5. Coradaro L. Bilateral simultaneous augmentation of the maxillary sinus fllor with particulated mandible. Report of a technique and preliminary results. Clin Oral Implants Res 2003;14:201–206.
6. Blomqvist JE, Alberius P, Isaksson S. Retrospective analysis of one-stage maxillary sinus augmentation with endosseous implants. Int J Oral Maxillofac Implants 1996;11:512–521.
7. Daelemans P, Hermans M, Godet F, Malevez C. Autologous bone graft to augment the maxillary sinus in conjunction with immediate endosseous implants: A retrospective study up to 5 years. Int J Periodontics Restorative Dent 1997; 17:27–39.
8. Jensen OT, Shulman LB, Block MS, Iacono VJ. Report of the Sinus Consensus Conference of 1996. Int J Oral Maxillofac Implants 1998; 13(suppl):11–45.
9. Boyne P, James R. Grafting the maxillary sinus floor with autogenous marrow and bone. J Oral Surg 1980;38:613–616.
10. Keller EE, Triplett WW. Iliac bone grafting: Review of 160 consecutive cases. J Oral Maxillofac Surg 1987;45:11–14.
11. Block MS, Kent JN. Sinus augmentation for dental implants: The use of autogenous bone. J Oral Maxillofac Surg 1997;55:1281–1286.
12. Block MS, Kent JN, Kallukaran FU, Thunthy K, Weinberg R. Bone maintenance 5 to 10 years after sinus grafting. J Oral Maxillofac Surg 1998;56:706–714.
13. Moy PK, Lundgren S, Holmes RE. Maxillary sinus augmentation: Histomorphometric analysis of graft materials for maxillary sinus floor augmentation. J Oral Maxillofac Surg 1993;51:857–862.
14. Lundgren S, Moy P, Johansson C, Nilsson H. Augmentation of the maxillary sinus floor with particulate mandible: A histologic and histomorphometric study. Int J Oral Maxillofac Implants 1996;11:760–766.

15. Leder AJ, McElroy J, Deasy MJ. Reconstruction of the severely atrophic maxilla with autogenous iliac bone graft and hydroxylapatite/decalcified freeze-dried bone allograft in the same patient: A preliminary report. Periodontal Clin Investig 1993;15:5–9.
16. Nishibori M, Betts NJ, Salama H, Listgarten MA. Short-term healing of autogenous and allogeneic bone grafts after sinus augmentation: A report of 2 cases. J Periodontol 1994;65:958–966.
17. Haas R, Haidvogl D, Donath K, Watzek G. Freeze-dried homogeneous and heterogeneous bone for sinus augmentation in sheep. Part I: Histological findings. Clin Oral Implants Res 2002;13:396–404.
18. Wallace SS, Froum SJ, Tarnow DP. Histologic evaluation of a sinus elevation procedure: A clinical report. Int J Periodontics Restorative Dent 1996;16:46–51.
19. Jensen OT, Sennerby L. Histologic analysis of clinically retrieved titanium microimplants placed in conjunction with maxillary sinus floor augmentation. Int J Oral Maxillofac Implants 1998;13:513–521.
20. Lorenzetti M, Mozzati M, Campanino PP, Valente G. Bone augmentation of the inferior floor of the maxillary sinus with autogenous bone or composite bone grafts: A histologic-histomorphometric preliminary report. Int J Oral Maxillofac Implants 1998;13:69–76.
21. Groeneveld EH, van den Bergh JP, Holzmann P, ten Bruggenkate CM, Tuinzing DB, Burger EH. Histomorphometrical analysis of bone formed in human maxillary sinus floor elevations grafted with OP-1 device, demineralized bone matrix or autogenous bone. Comparison with non-grafted sites in a series of case reports. Clin Oral Implants Res 1999;10:499–509.
22. Schlickewei W, Paul C. Experimentelle Untersuchung zum Knochenersatz mit bovinem Apatit. In: Huggler AH, Kuner EH (eds). Aktueller Stand beim Knochenersatz. Hefte zur Unfallheikunde. Berlin: Springer, 1991:59–69.
23. Hallman M, Sennerby L, Lundgren S. A clinical and histologic evaluation of implant integration in the posterior maxilla after sinus floor augmentation with autogenous bone, bovine hydroxyapatite, or a 20:80 mixture. Int J Oral Maxillofac Implants 2002;17:635–643.
24. Carmagnola D, Adriaens P, Berglundh T. Healing of human extraction sockets filled with Bio-Oss. Clin Oral Implants Res 2003;14:137–143.
25. Pasetti P. Prelievo di osso dalla cavita orale. Int J Dent Symp 1994;2:46–51.
26. Sindet-Pedersen S, Enemark H. Mandibular bone grafts for reconstruction of alveolar clefts. J Oral Maxillofac Surg 1988;46:533–537.
27. Sindet-Pedersen S, Enemark H. Reconstruction of alveolar clefts with mandibular or iliac crest bone grafts: A comparative study. J Oral Maxillofac Surg 1990;48:554–558.
28. Hoppenreijs TJ, Nijdam ES, Freihofer HP. The chin as a donor site in early secondary osteoplasty: A retrospective clinical and radiological evaluation. J Craniomaxillofac Surg 1992;20:119–124.
29. Nkenke E, Schultze-Mosgau S, Radespiel-Tröger M, Kloss F, Neukam FW. Mobidity of harvesting of chin grafts: A prospective study. Clin Oral Implants Res 2001;12:495–502.
30. Raghoebar GM, Louwerse C, Kalk WWI, Vissink A. Morbidity of chin bone harvesting. Clin Oral Implants Res 2001;12:503–507.
31. Daoudi A. Implants dentaires. Apport du greffon d'os iliaque. Rev Stomatol Chir Maxillofac 1992;93:217.
32. Tolman DE. Reconstructive procedures with endosseous implants in grafted bone: A review of the literature. Int J Oral Maxillofac Implants 1995;10:275–294.
33. Leyder P, Mercier C, Devauchelle B, Molhant G. Le prelevement iliaque posterieur. Faudrait—il y penser plus souvent? Rev Stomatol Chir Maxillofac 1985;86:255–258.
34. Hall MB, Vallerand WP, Thompson D, Hartley G. Comparative anatomic study of anterior and posterior iliac crests as donor sites. J Oral Maxillofac Surg 1991;49:560–563.
35. Stoll P, Schilli W. Long-term follow-up of donor and recipient sites after autologous bone grafts for reconstruction of the facial skeleton. J Oral Surg 1981;39:676–677.
36. Marx RE, Morales MJ. Morbidity from bone harvest in major jaw reconstruction: A randomized trial comparing the lateral anterior and posterior approaches to the ilium. J Oral Maxillofac Surg 1988;8:196–203.
37. Tayapongsak P, Wimsatt JA, La Bano JP, Dolwick MF. Morbidity from anterior ilium bone harvest. A comparative study of lateral versus medial surgical approach. J Oral Surg 1994;78:296–300.
38. Reid RL. Hernia through an iliac bone-graft donor site: A case report. J Bone Joint Surg Am 1968;50:757.
39. Escalas F, DeWald RL. Combined traumatic arteriovenous fistula and ureteral injury: A complication of iliac bone-grafting: A case report. J Bone Joint Surg Am 1977;59:270.
40. Cockin J. Autologous bone grafting—Complications at the donor site. J Bone Joint Surg Br 1971;53:153.
41. Challis JH, Lyttle JA, Stuart AE. Strangulated lumbar hernia and volvulus following removal of iliac crest bone graft: A case report. Acta Orthop Scand 1975;46:230.
42. James JD, Geist ET, Gross BD. Adynamic ileus as a complication of iliac bone removal: Report of two cases. J Oral Surg 1981;39:289–291.
43. Laurie SWS, Kaban LB, Mulliken JB, et al. Donor-site morbidity after harvesting rib and iliac bone. Plast Reconstr Surg 1984;73:933.
44. Jamshidi K, Swaim WR. Bone marrow biopsy with unaltered architecture: A new biopsy device. J Lab Clin Med 1971;77:335–342.
45. American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists. Practice guidelines for sedation and analgesia by non-anesthesiologists. Anesthesiology 2002;96:1004–1017.
46. Lofgren L. Instrument for taking bone biopsies and for minor bone transplantations. Ann Chir Gynaecol Fenn 1968;57:351–353.
47. Dragoo MR, Irwin RK. A method of procuring cancellous iliac bone utilizing a trephine needle. J Periodontol 1972;43:82–87.
48. Gartsman GM, Lane JM. A simple method of obtaining bone graft by bone biopsy trocar. J Hand Surg [Am] 1981;6:627–628.
49. Tilley MG, Davis LF. Trephine technique to obtain cancellous bone. J Oral Maxillofac Surg 1984;42:64–65.
50. Altman K, Blenkinsopp PT. Use of the bone biopsy trephine to obtain iliac crest cancellous bone. J Oral Maxillofac Surg 1994;52:522–523.